Comparisons of CERES EBAF Ed2.7 TOA Fluxes with Reanalysis Data

Takmeng Wong
NASA Langley Research Center, Hampton, Virginia

CERES Science Team Meeting
San Diego, California
29-31 October, 2013

Objective

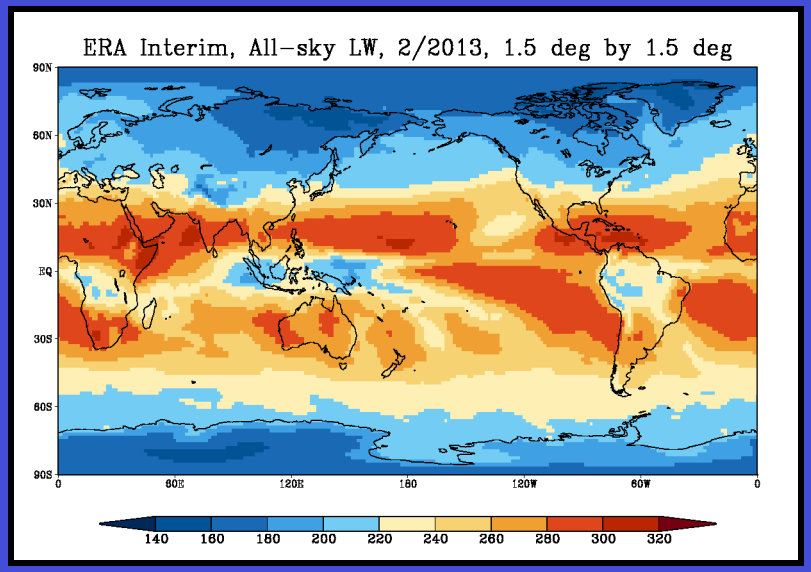
- Compare 13-year of CERES EBAF TOA radiation budget data (March 2000 to February 2013) with ERA Interim Reanalysis Data
  - Longwave, shortwave, net (all-sky and clear-sky), solar incoming
  - Regional and global (90N to 90S) scale
  - 13-year climatology (average)
  - Interannual variability (2-sigma)
  - Deseasonalized time series (globe and tropics)

Data Sets

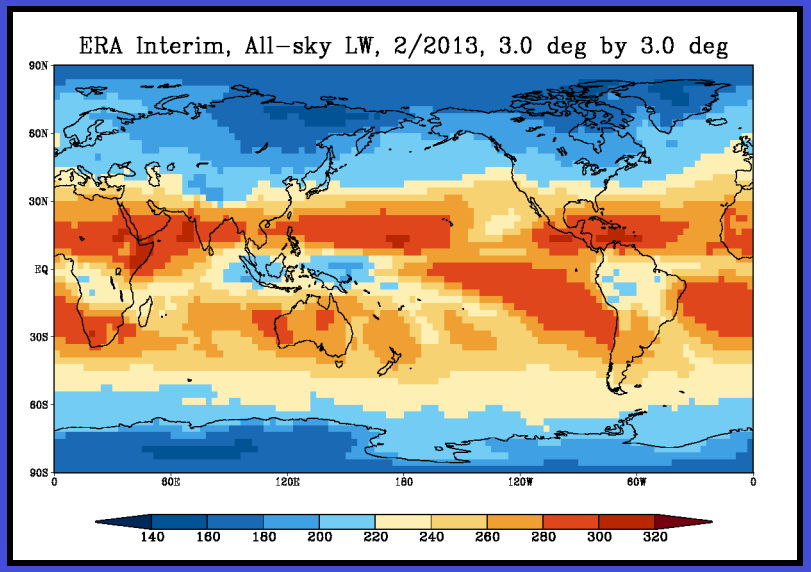
- CERES EBAF TOA Edition 2.7 Monthly Mean Data
  - 1 degree by 1 degree equal angle global grid in NetCDF format
  - Obtained from CERES data website http://ceres.larc.nasa.gov/order_data.php
- ERA Interim Reanalysis Monthly Mean Data
  - 1.5 degree by 1.5 degree equal angle global grid in NetCDF format
  - Obtained from ECMWF ERA Interim data website http://data-portal.ecmwf.int/data/d/interim_mnth/
  - ERA Interim has an error in solar incoming (~3 Wm^{-2} too high) http://www.ecmwf.int/research/era/do/get/index/QualityIssues

Data Regridding

- CERES and ERA Interim data are regridded to a 3 degree by 3 degree grid to facilitate comparison of these data sets
- Regridding is done using weighted-average procedure to minimize regridding noise (no interpolation) and to preserve the quality of the global mean values



ERA Interim, Original Data



ERA Interim, Regridded Data

Data Regridding (Continue)

- Regridded data have the exact same global mean values as the original data; very similar but slightly smaller spatial variability

ERA Interim 13-year Climatology (March 2000 to February 2013)

ERA Interim	Original Mean	Original 1-σ	Regridded Mean	Regridded 1-σ
Solar Inc.	344.2*	88.8	344.2*	88.4
All-sky LW	245.5	37.0	245.5	36.6
All-sky SW	100.2	16.4	100.2	15.7
All-sky Net	-1.5	61.4	-1.5	61.0
Clr-sky LW	264.0	40.9	264.0	40.3
Clr-sky SW	53.7	28.0	53.7	27.4
Clr-sky Net	26.5	70.4	26.5	69.9

** ERA Interim has an error in the solar incoming (~ 3 Wm^{-2} too high) (http://www.ecmwf.int/research/era/do/get/index/QualityIssues)*

ERA Interim Solar Correction

- Apply simple solar correction factor (1365/1377) to solar incoming and reflected SW; recalculate Net using these two new values

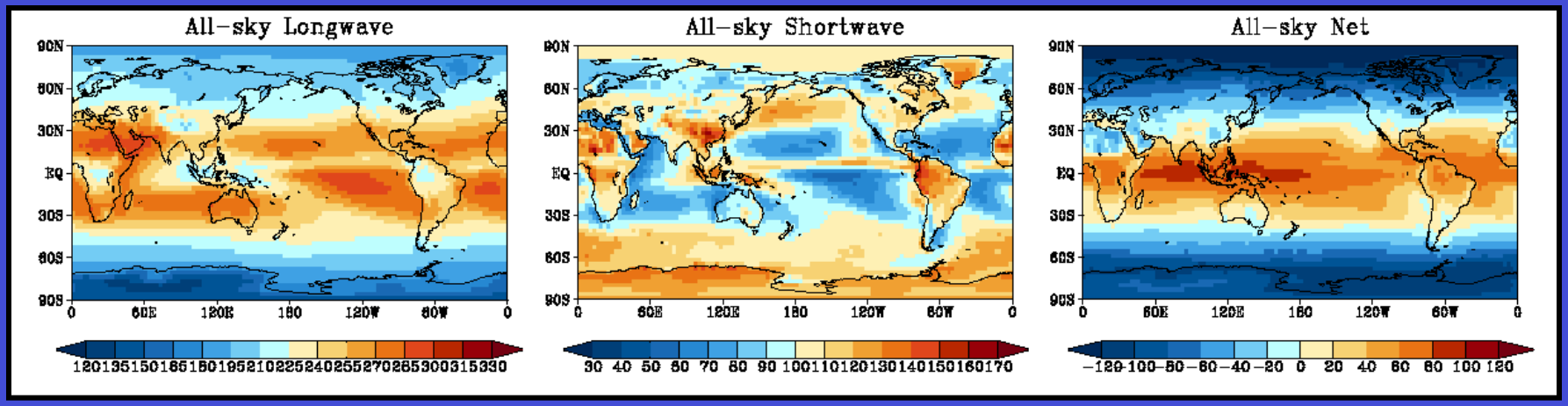
ERA Interim 13-year Climatology (March 2000 to February 2013)

ERA-Interim	Uncorrected Mean	Uncorrected 1-σ	Corrected Mean	Corrected 1-σ
Solar Inc.	*344.2**	*88.4*	*341.2*	*87.6*
All-sky LW	*245.5*	*36.6*	*245.5*	*36.6*
All-sky SW	*100.2*	*15.7*	*99.3*	*15.6*
All-sky Net	*-1.5*	*61.0*	*-3.6*	*60.2*
Clr-sky LW	*264.0*	*40.3*	*264.0*	*40.3*
Clr-sky SW	*53.7*	*27.4*	*53.2*	*27.2*
Clr-sky Net	*26.5*	*69.9*	*24.0*	*69.0*

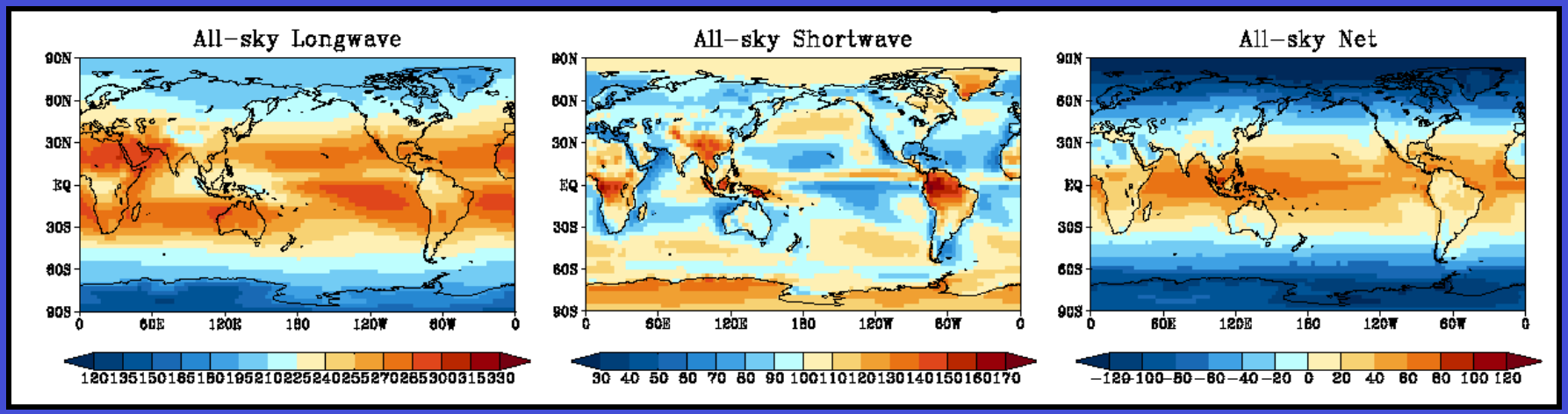
** ERA Interim has an error in the solar incoming (~ 3 Wm^{-2} too high) (http://www.ecmwf.int/research/era/do/get/index/QualityIssues)*

All-sky TOA Climatology (3/2000 to 2/2013)

CERES EBAF Ed2.7

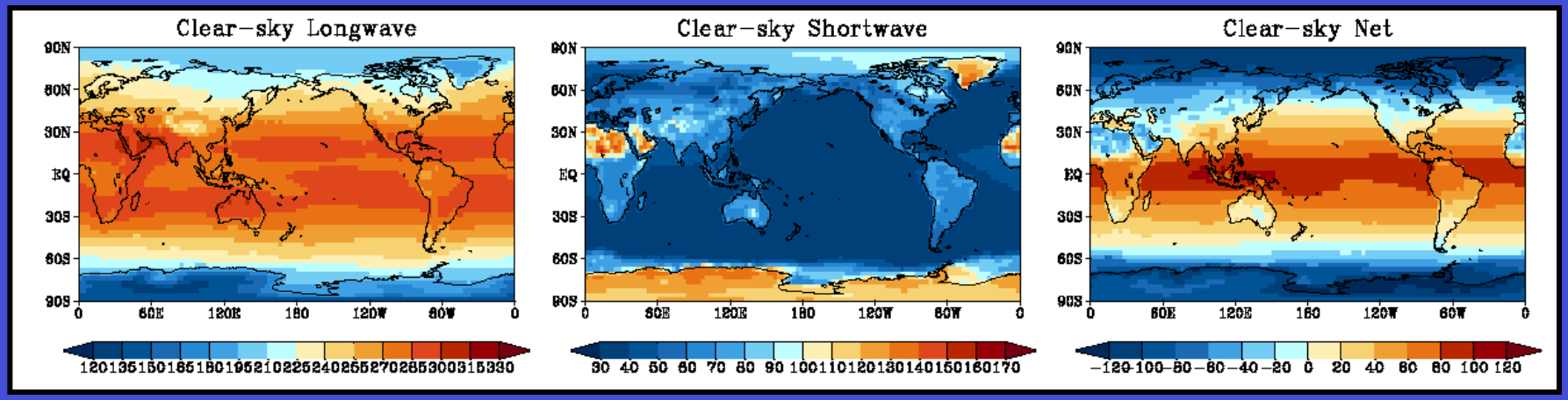


ERA Interim

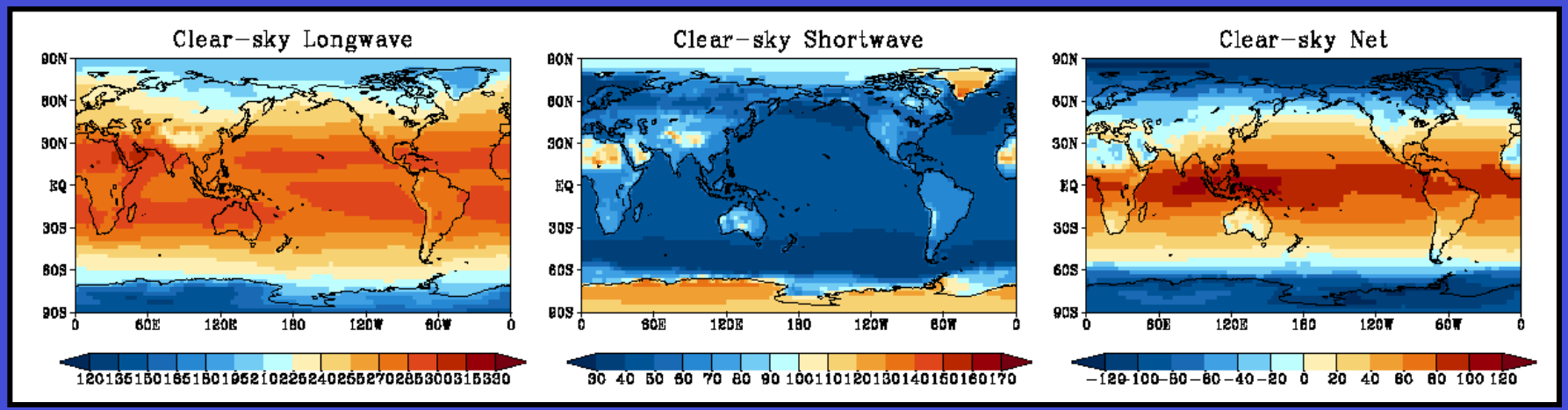


Clear-sky TOA Climatology (3/2000 to 2/2013)

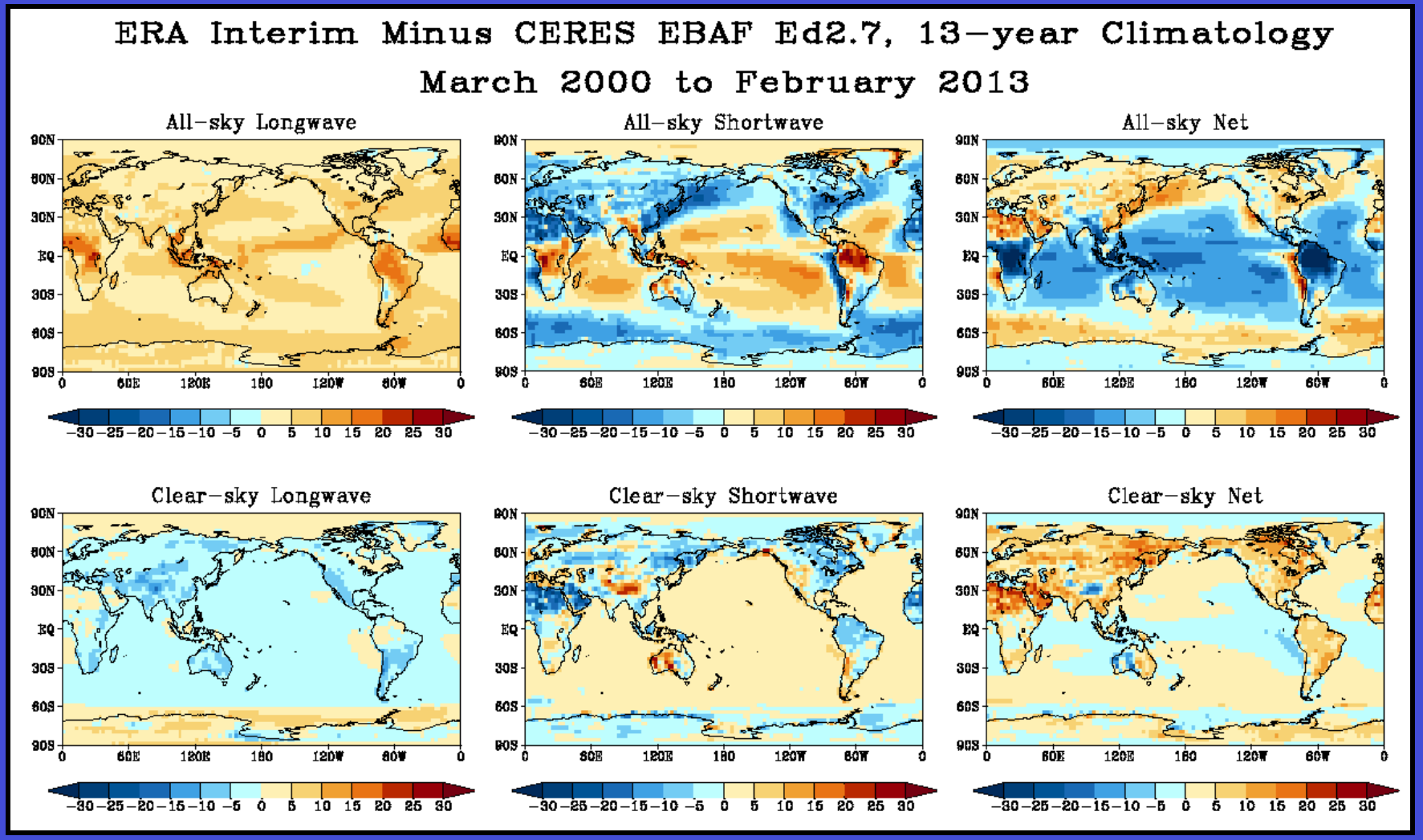
CERES EBAF Ed2.7



ERA Interim



ERA Interim Minus CERES TOA Differences



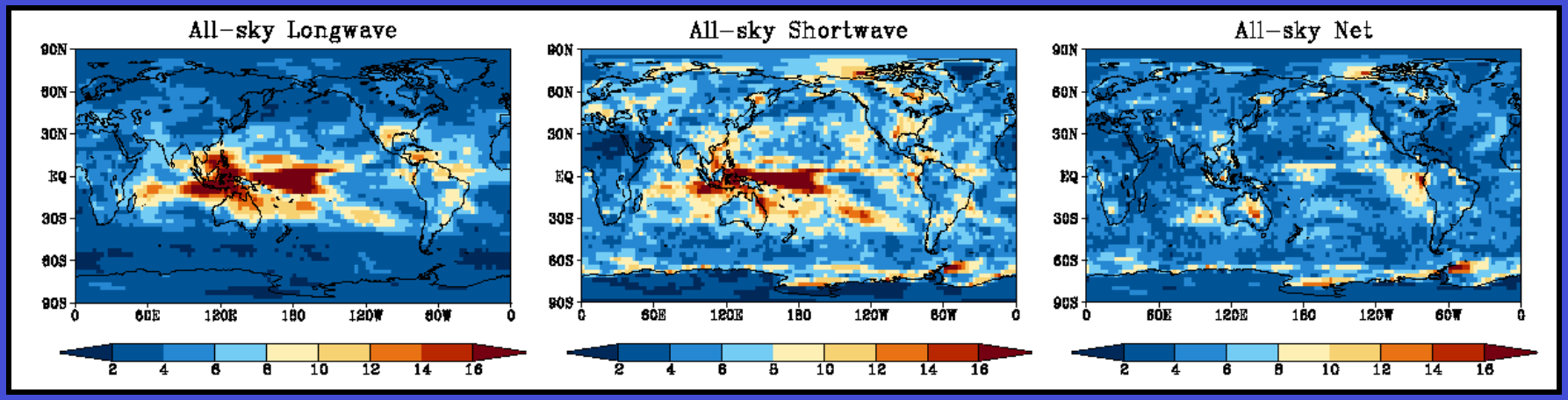
Global (90NS) Mean Comparison

Parameters (Wm^{-2})	ERA Int. 13y-avg	CERES 13y-avg	Mean Diff. ERA-Ceres
Solar Incoming	341.2	339.9	1.3 (0.4%)
Longwave	245.5	239.6	5.9 (2.5%)
Shortwave	99.3	99.7	-0.4 (-0.4%)
Net	-3.6	0.6	-4.2 (-700%)
Clear Longwave	264.0	265.6	-1.6 (-0.6%)
Clear Shortwave	53.2	52.6	0.6 (1.1%)
Clear Net	24.0	21.7	2.3 (10.6%)

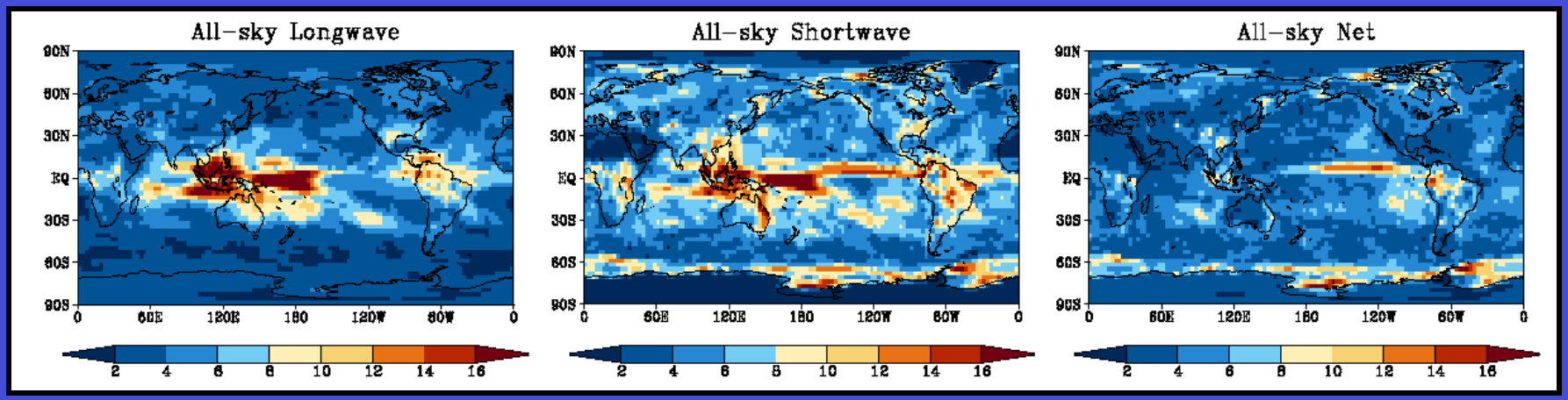
- All-sky: ERA Interim has higher global mean values of Solar incoming and outgoing LW; but lower values of SW and Net
- Clear-sky: ERA Interim has lower global mean values of outgoing LW ; but higher values of SW and Net

All-sky TOA Interannual Variability

CERES EBAF Ed2.7

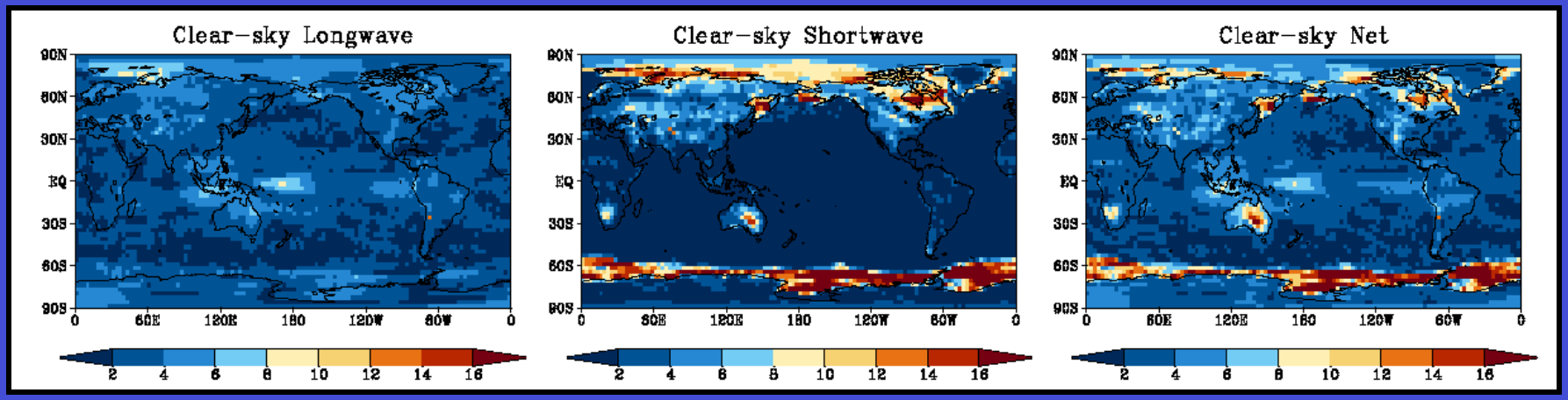


ERA Interim

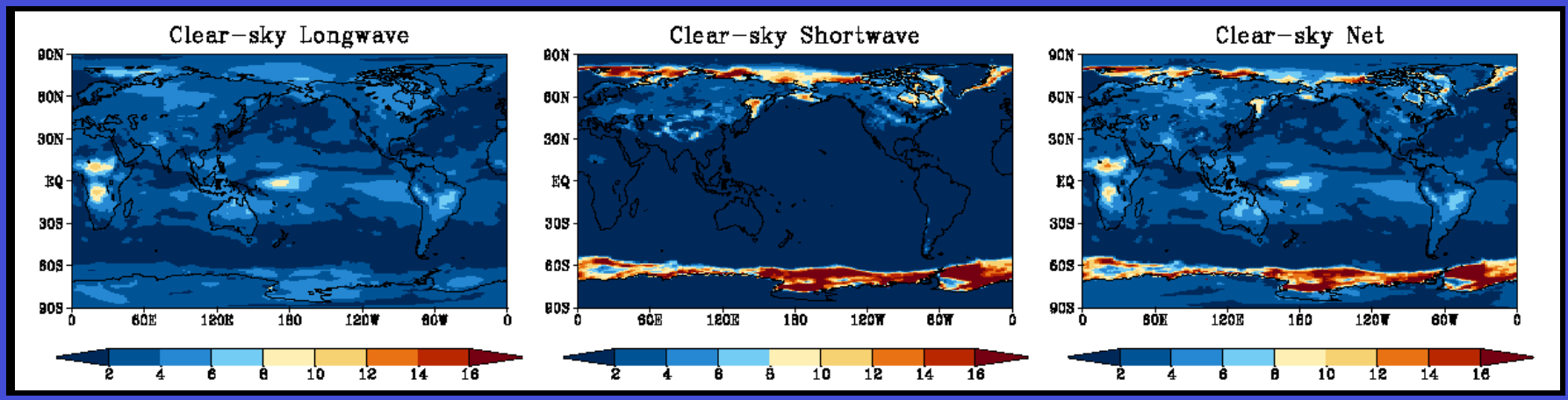


Clear-sky TOA Interannual Variability

CERES EBAF Ed2.7



ERA Interim

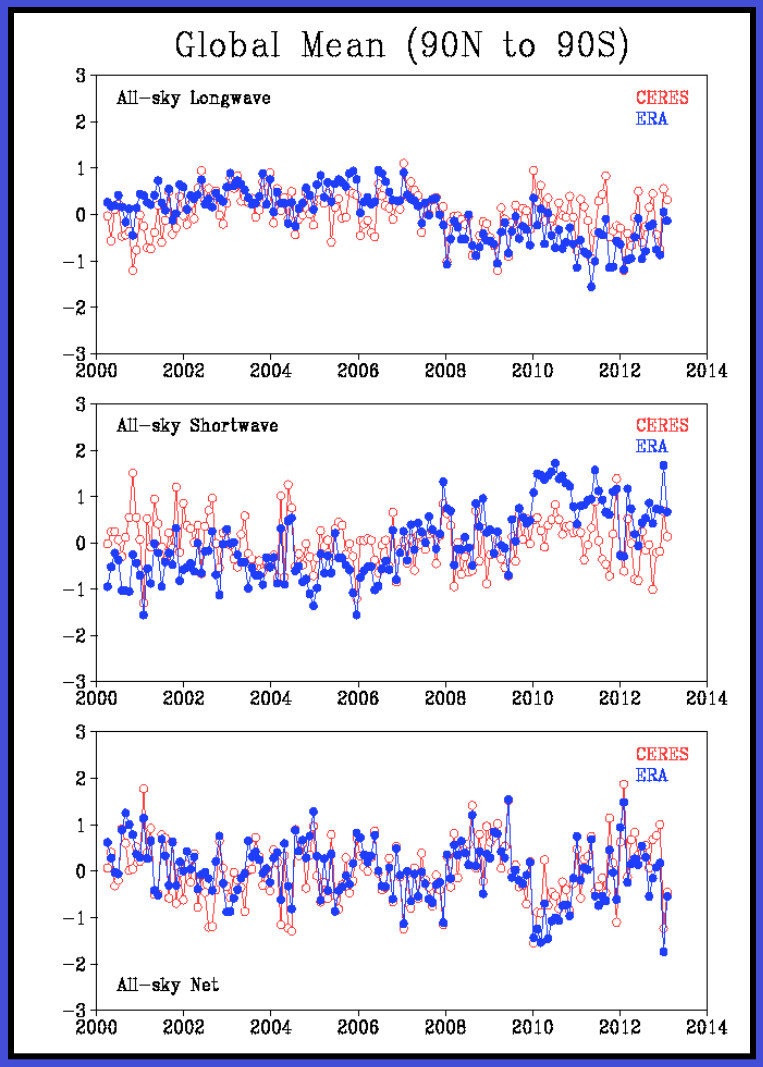


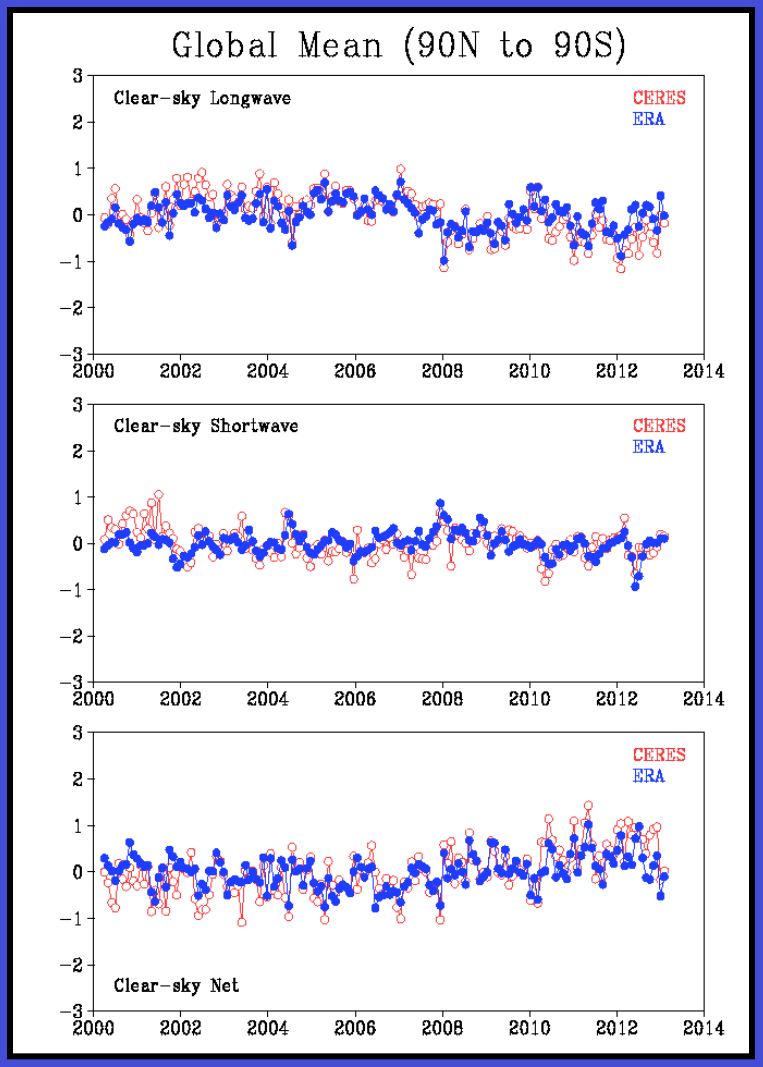
Global (90NS) Mean and Interannual Variability

Parameters (Wm^{-2})	ERA Int. 10y-avg	CERES 10y-avg	Mean Diff. ERA-Ceres	ERA Int 2-σ	CERES 2-σ
Solar Incoming	341.2	339.9	1.3 (0.4%)	0.01	0.20
Longwave	245.5	239.6	5.9 (2.5%)	0.96	0.47
Shortwave	99.3	99.7	-0.4 (-0.4%)	1.26	0.42
Net	-3.6	0.6	-4.2 (-700%)	0.66	0.58
Clear Longwave	264.0	265.6	-1.6 (-0.6%)	0.40	0.67
Clear Shortwave	53.2	52.6	0.6 (1.1%)	0.24	0.31
Clear Net	24.0	21.7	2.3 (10.6%)	0.40	0.68

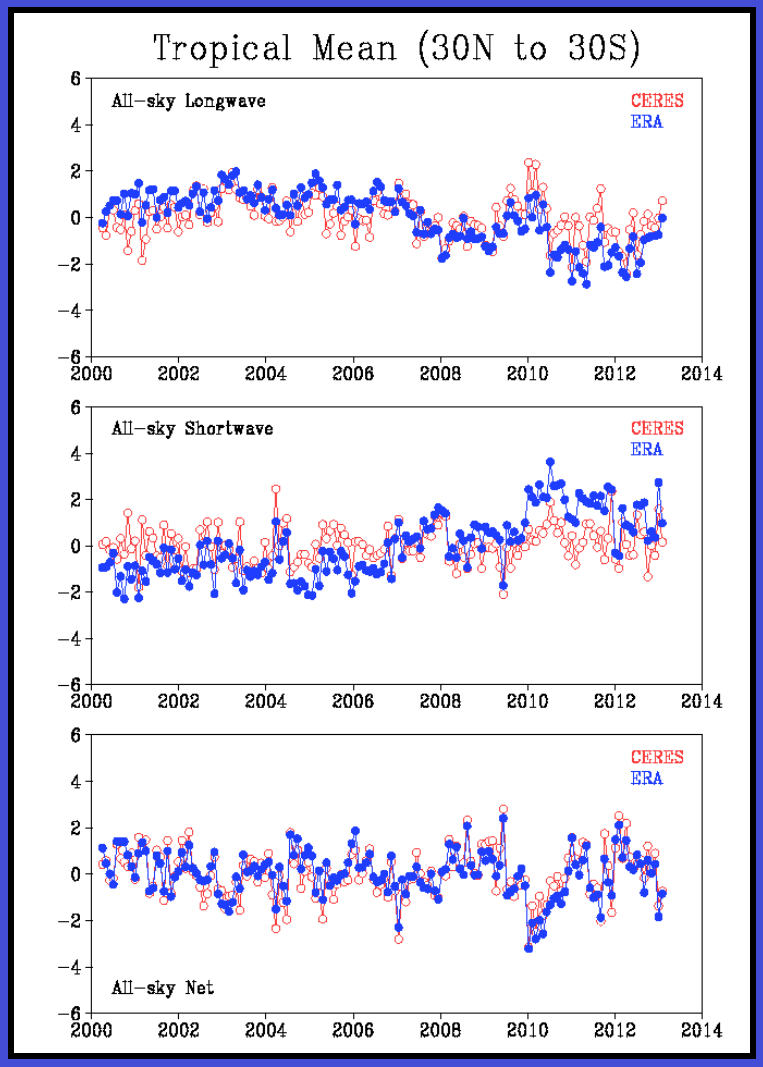
- ERA Interim has slightly higher interannual variability of all-sky fluxes; but slightly lower interannual variability of clear-sky fluxes
- ERA Interim uses a constant solar irradiance value while CERES uses a time varying solar irradiance observations from SORCE

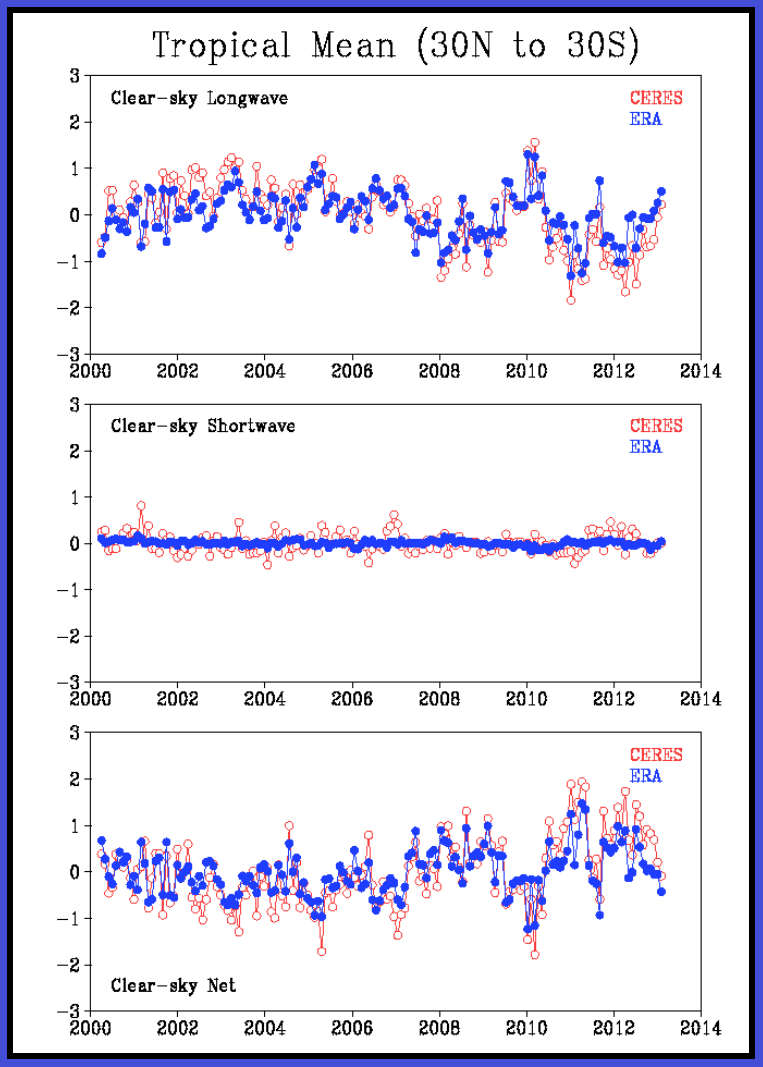
Global Mean Deseasonalized Time Series





Tropical Mean Deseasonalized Time Series





Summary

- ERA Interim has an error in solar incoming (~3 Wm^{-2} too high)
- ERA Interim uses a constant solar irradiance value. CERES EBAF uses a time varying solar irradiance from SORCE with a solar constant ~ 1361; leads to differences in solar incoming between these two datasets
- ERA Interim global mean all-sky longwave are much higher than CERES values (by 6 Wm^{-2}).; leads to large differences in global mean all-sky net fluxes
- Larger regional (land vs. ocean) differences are found in all-sky shortwave, all-sky net and clear-sky shortwave flux.
- Globally, ERA Interim has slightly higher interannual variability of all-sky fluxes; but slightly lower interannual variability of clear-sky fluxes than CERES
- Global mean time series are very similar. However, there are some larger differences in all-sky SW and LW times series after 2010